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INTRA-BLOC AND INTERNATIONAL TELECOMMUNICATIONS OF THE SINO-SOVIET BLOC 1950–65

CIA/RR ER 61-18

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CENTRAL INTELLIGENCE AGENCY

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FOREWORD

This report focuses sharply on two significant fields of telecommunications services of the Sino-Soviet Bloc as a whole: intra-Bloc services and international services. Only the principal services and trunk routes are considered. Functional systems and services used by specialized entities for specialized services are not considered.

The strategic implications of a recent trend among the Bloc countries toward the solution of mutual telecommunications problems by the coordinated application of modern technology enhances the intelligence timeliness of this report.

To insure sharp focus on intra-Bloc and international aspects of the subject matter, this report avoids treatment of related detail.

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Appendixes

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Maps

INTRA-BLOC AND INTERNATIONAL TELECOMMUNICATIONS OF THE SINO-SOVIET BLOC* 1950-65

Summary and Conclusions

Intra-Bloc telecommunications services assist in "tying" together rapidly the varied military, political, economic, and mass "education" activities of the Sino-Soviet Bloc. International telecommunications** services facilitate Bloc*** interests and penetration activities abroad.

Present telecommunications resources fulfill over-all Bloc needs but with facilities that are old and primitive. Many telecommunications systems have equipment that is incompatible, and still others fall far short of the demand for traffic-handling capacity. Only a handful of existing facilities are capable of long-distance transmission of television programs. Few meet international standards set forth by the technical committees of the International Telecommunication Union (ITU). In general, intra-Bloc facilities are considered to be "soft," or vulnerable, in that most facilities are above ground, where they are subject to natural and man-made destruction, in contradistinction to "hardened" underground construction.

To overcome many of these admitted shortcomings, the Bloc has created mechanisms to plan for and to implement the provision of greatly enlarged facilities for both intra-Bloc and international telecommunications. These actions are consistent with over-all Bloc objectives to strengthen its power at home and to assert that power more forcefully abroad.

Prospects for fulfillment of the telecommunications plans by the Bloc by 1965 are good but not assured. Uneven appreciation of research and development efforts, shortages of fabricating capacity for the civil sector, and inadequate supplies of highly trained technicians to install, operate, and maintain modern complex equipment will complicate, if not retard, plan schedules.

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* The estimates and conclusions in this report represent the best judgment of this Office as of 1 March 1961. Technical terms are defined in Appendix A, Glossary of Technical Terms.

** The term international telecommunications as used in this report refers to telecommunications between Sino-Soviet Bloc countries and the rest of the world.

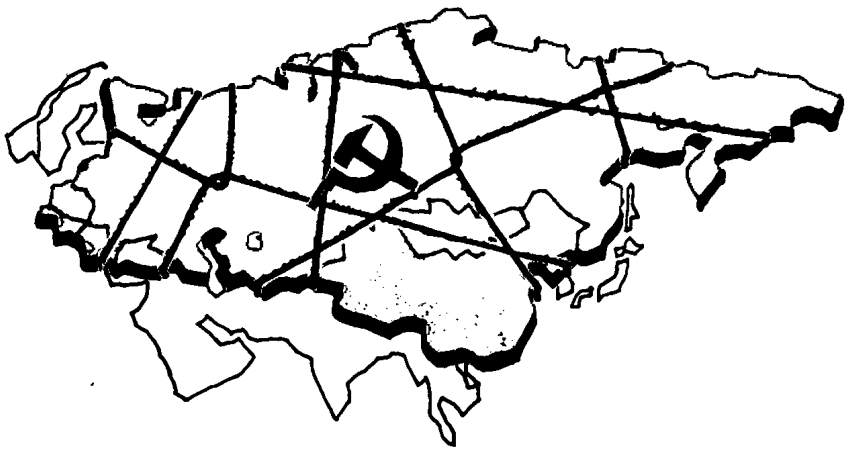
*** Unless otherwise indicated, the term Bloc as used in this report refers to the Sino-Soviet Bloc.

I. Introduction

Within the framework of the economic, political, and military goals of the Sino-Soviet Bloc, telecommunications has played an important part, and it is expected that this part will continue to grow in stature as extensive new facilities are provided to meet rising needs. As the countries of the Bloc develop and their activities become complex and more interwoven, there falls to services such as telecommunications the need to tie these "separate" states more closely together so that their activities can rapidly be given better direction and sharper focus. The effects of these services are closer control, accelerated coordination, intensified integration, and improved mass "education." Domestic telecommunications services produce these effects internally for each country, but it is the intra-Bloc and international services, treated in this report, that help to bind the Bloc together to achieve its internal and external goals -- economic, political, and military.

II. Telecommunications Facilities and Their Utilization, 1960

A. Intra-Bloc



The basic telephone and telegraph networks of the countries of the Bloc provide the main arteries for rapid electric intra-Bloc communications. Using open wireline and multiconductor cable, these networks carry telephone, regular telegraph, TELEX (subscriber teletype service), data, and facsimile services to state enterprises, military organizations, political and administrative bodies, and the general public. The map, Figure 1,* shows the main telecommunications arteries

* Following p. 4.

(1960 and 1965) among the countries of the Bloc. Lines such as these largely carry or will carry the burden of "tying" the countries of the Bloc together, as figuratively represented above, into a more cohesive force for achieving Communist goals.

Radiobroadcasting and television services provide the broad basis for mass communications. Using radiobroadcasting and television transmitters, these facilities broadcast amplitude-modulated (AM) and frequency-modulated (FM) radio and television services throughout the Bloc. The map, Figure 2,* shows the estimated coverage of AM radio transmitters in the Bloc engaged in domestic service that reach beyond domestic borders and portrays the intra-Bloc character of essentially domestic radiobroadcasting service. The same is true of the map, Figure 3,* which shows the estimated coverage of FM radio transmitters and television stations in the Bloc engaged in domestic service that also reach beyond domestic borders. It was these facilities taken together that led Sergey Kaftanov, Chairman of the State Committee for Radiobroadcasting and Television in the USSR, to say that they constitute "a most important means /for/ the ideological and political education of the /Bloc/." 2/

In addition to carrying telephone and telegraph services, some main arteries relay radio and television programs. The lines that make up the television network of the Bloc, "Intervision," are shown on the map, Figure 4.* They linked only four countries of the Bloc in 1960, but eventually the network is to include all countries of the Bloc. 3/

B. International

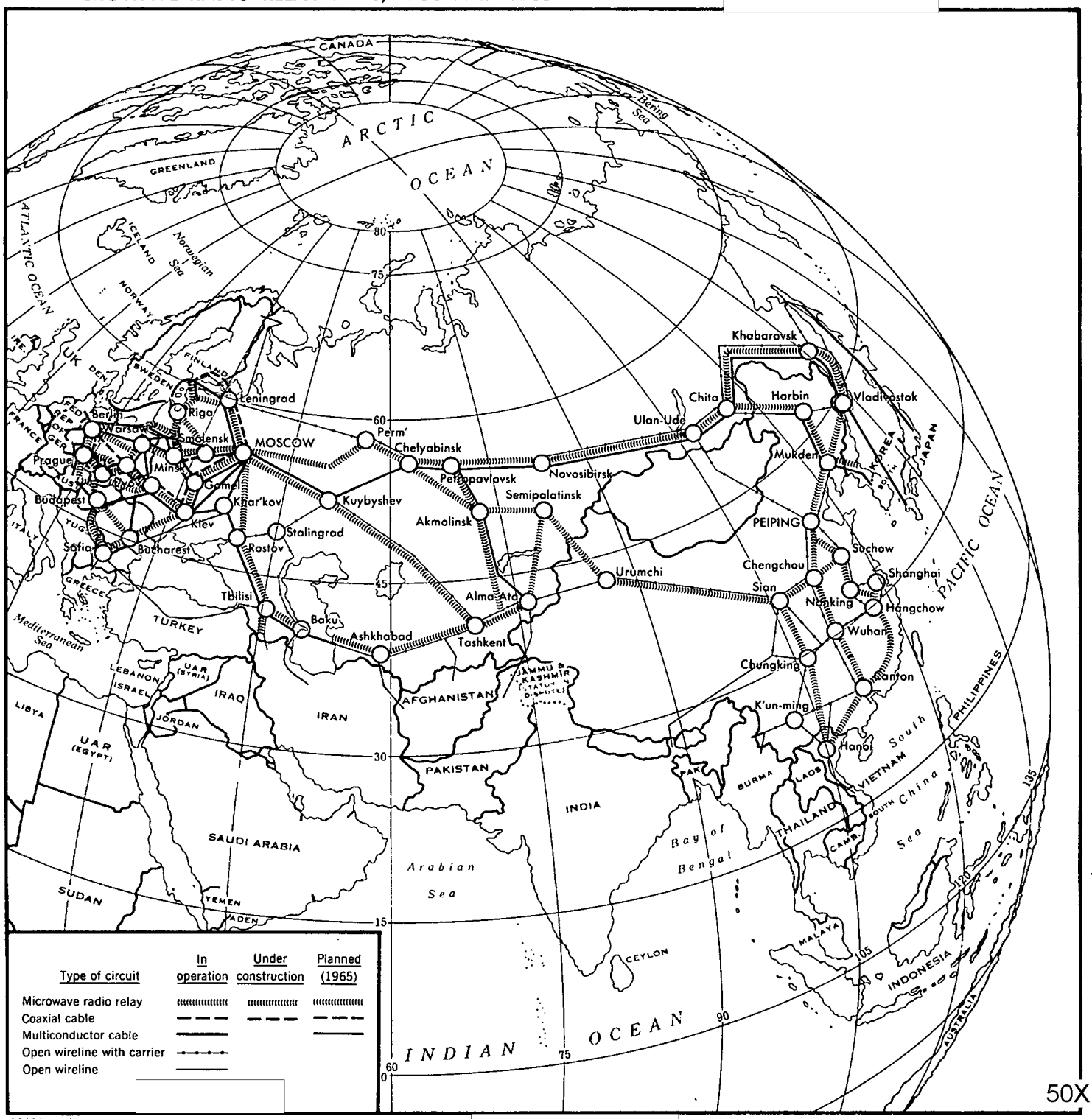
The basic telephone and telegraph networks of the countries of the Bloc also provide the main arteries for international telecommunications. Using open wireline, cable, and point-to-point radio

* Following p. 4.

SINO-SOVIET BLOC: MAIN INTRA-BLOC WIRELINE, CABLE, AND MICROWAVE RADIO RELAY LINES, 1960 AND 1965

FIGURE 1

50X1



Type of circuit	In operation	Under construction	Planned (1965)
Microwave radio relay			
Coaxial cable			
Multiconductor cable			
Open wireline with carrier			
Open wireline			

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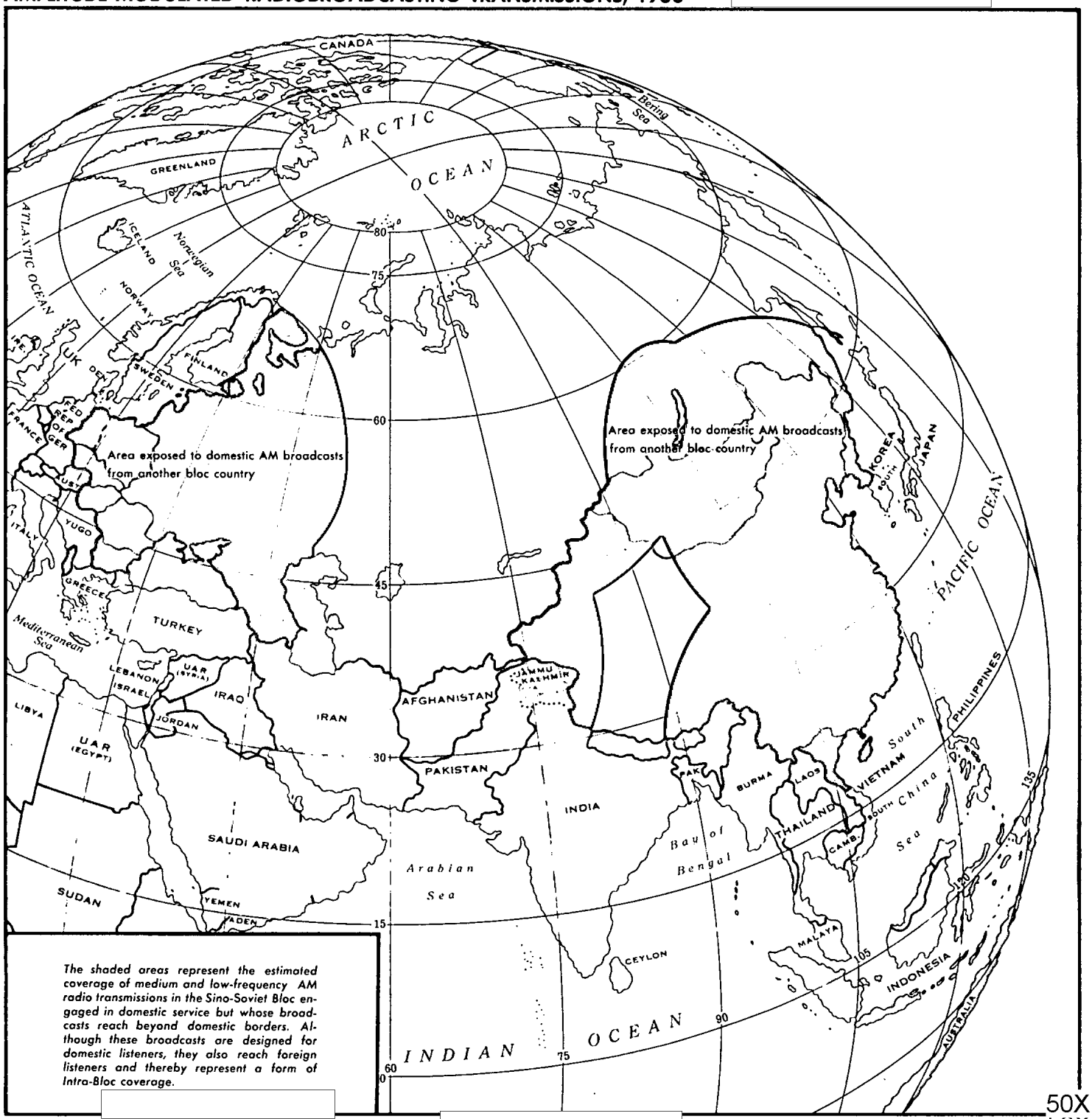
50X1

50X1

SINO-SOVIET BLOC: INTRA-BLOC COVERAGE OF DOMESTIC AMPLITUDE-MODULATED RADIOBROADCASTING TRANSMISSIONS, 1960

FIGURE [redacted]

50X1



The shaded areas represent the estimated coverage of medium and low-frequency AM radio transmissions in the Sino-Soviet Bloc engaged in domestic service but whose broadcasts reach beyond domestic borders. Although these broadcasts are designed for domestic listeners, they also reach foreign listeners and thereby represent a form of Intra-Bloc coverage.

[redacted]

[redacted]

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50X1

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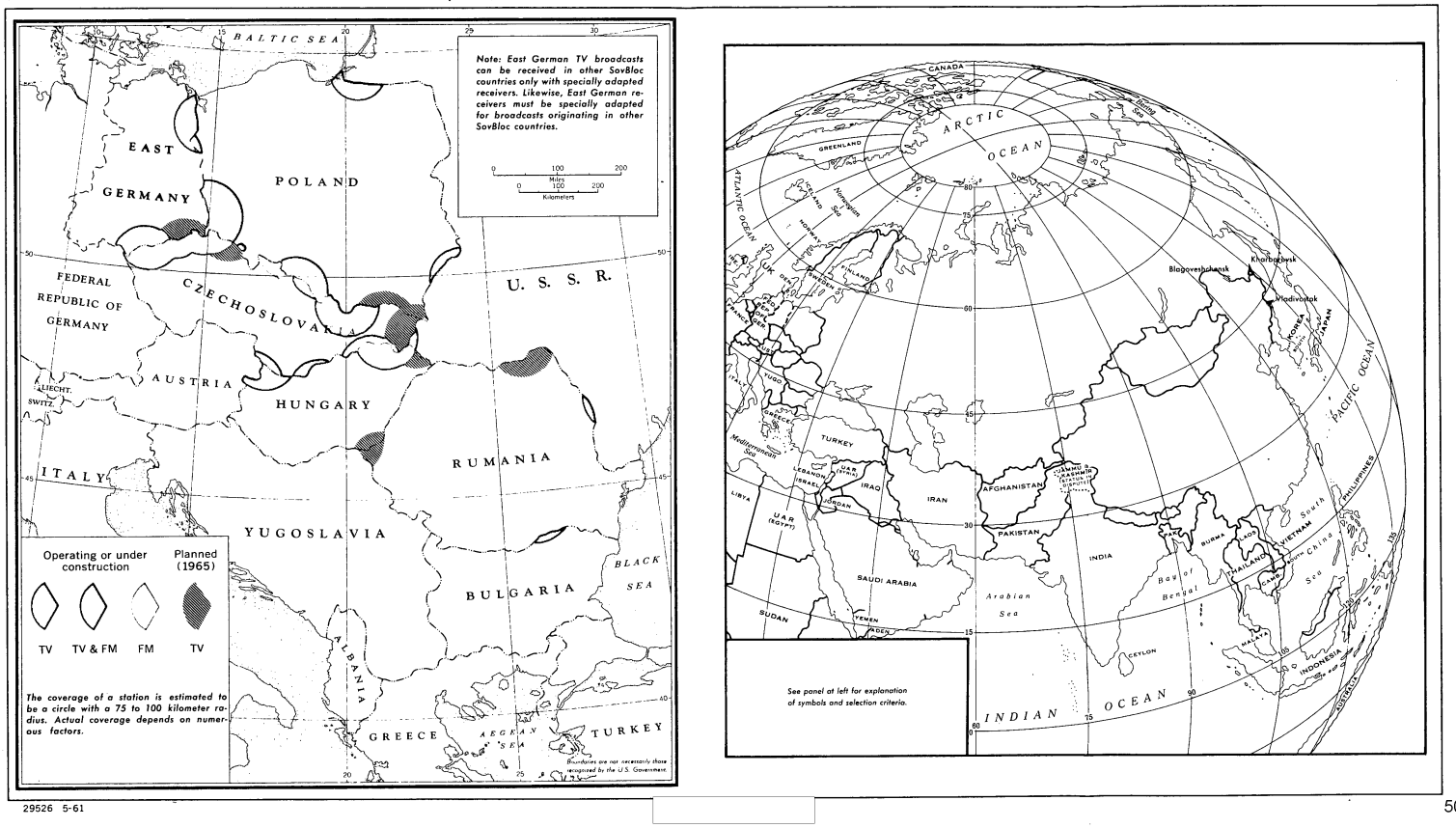
50X1

SINO-SOVIET BLOC: INTRA-BLOC COVERAGE OF DOMESTIC, FREQUENCY-MODULATED RADIOBROADCASTING AND TELEVISION TRANSMISSIONS; 1960 AND 1965

FIGURE 3



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50X1

SINO-SOVIET BLOC: INTRA-BLOC "INTERVISION" TELEVISION NETWORK, 1960 AND 1965

FIGURE 4

50X1

29531 5-61

50X1

50X1

facilities, these networks carry telephone, regular telegraph, TELEX, and facsimile services. The map, Figure 5,* shows the main landline arteries between the Bloc and the rest of the world, and the map, Figure 6,* shows the main radio arteries between the Bloc and the rest of the world. It is these lines that help extend the activities of the Bloc directly throughout the world, as figuratively represented above.

Telecommunications support the program of the Bloc for penetration by means of broadcasting, by the export of equipment and technicians, and by the establishment of direct telecommunications circuits for operational purposes. The maps, Figures 7 and 8,* illustrate the domestic broadcasting facilities of the Bloc that reach beyond individual country borders. The map, Figure 9,* which is discussed in connection with the growth of international radiobroadcasting in the following section, shows the main target areas of international radiobroadcasting by the Bloc. Also using "Intervision" connections,** the Bloc occasionally exchanges live television programs with the countries of Western Europe over the "Eurovision" network.*** The map, Figure 10,* indicates the coverage of the two television networks. The future use of this combined coverage, when the "Intervision" network is completed, is a major unknown factor that could be a powerful propaganda force for either the Bloc or the countries of Western Europe.

The export of telecommunications equipment and technicians is of particular importance because of the strategic nature of telecommunications facilities. The establishment of direct radio circuits under the guise of support for "helpful missions," "news agencies," and the like is a newer and more menacing threat. Such circuits provide close control and coordination of penetrative activities of the Bloc in countries subject to Communist expansion and avoid the use of relay facilities of non-Bloc countries. 4/

III. Growth of Telecommunications, 1950-60

A. Telecommunications Facilities and Services

Telecommunications facilities and services among the countries of the Bloc and between the Bloc and the rest of the world increased and improved during 1950-60. In 1950, only telephone and regular telegraph services were available. Because of the poor condition of wirelines and cable lines, the reliability of these services was not high.

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* Following p. 6.

** See IV, A, p. 9, below.

*** "Eurovision" is the name of the television network connecting countries of Western Europe.

Most of the attention of the telecommunications authorities in the countries of the Bloc was devoted to purely domestic problems in trying to cope with the demands of their own economies just beginning to gain momentum after the reconstruction years following World War II.

In the mid-1950's the importance of intra-Bloc and international telecommunications began to be recognized. Regular telephone and telegraph services were improved. Specialized services, such as TELEX and facsimile, were introduced. Plans were devised for the installation of high-capacity, multipurpose, multiuser microwave radio relay and coaxial cable lines for mainline routes. Microwave radio relay lines amounted to only an estimated total of 1,100 kilometers (km) in 1955, and most of these facilities were used solely for domestic services. Coaxial cable lines were in the planning stage. Organizations to view telecommunications objectives on a Blocwide basis, such as the Council for Mutual Economic Assistance (CEMA), the Warsaw Pact, and the Organization for Cooperation Among the Socialist Countries in the Fields of Post and Communications (OSS), were being formed or given impetus.

By 1960 the results of many of the efforts, begun in the middle years of the decade, were becoming evident. All countries of the Bloc were engaged in automating their domestic telephone networks as a prelude to future automation on a Blocwide basis. The regular telegraph service for intra-Bloc use was improved by the formation of a GENTEX network. This network provides special circuits employing either semiautomatic or automatic switching equipment to speed telegraph traffic among the countries of the European Satellites and the USSR. In addition to TELEX and facsimile service, which had been augmented and improved since 1955, data transmission service was introduced. The construction of modern facilities was begun in earnest. Microwave radio relay lines -- although mostly of relatively low capacity (24 telephone channels) -- were extended to 16,000 km, and coaxial cable lines amounted to about 1,000 km. Other modern types of common facilities such as tropospheric, ionospheric, and meteor-burst radio scatter techniques were employed on a few experimental circuits in 1960. The activities of CEMA and OSS were well established and had begun to function effectively. 5/

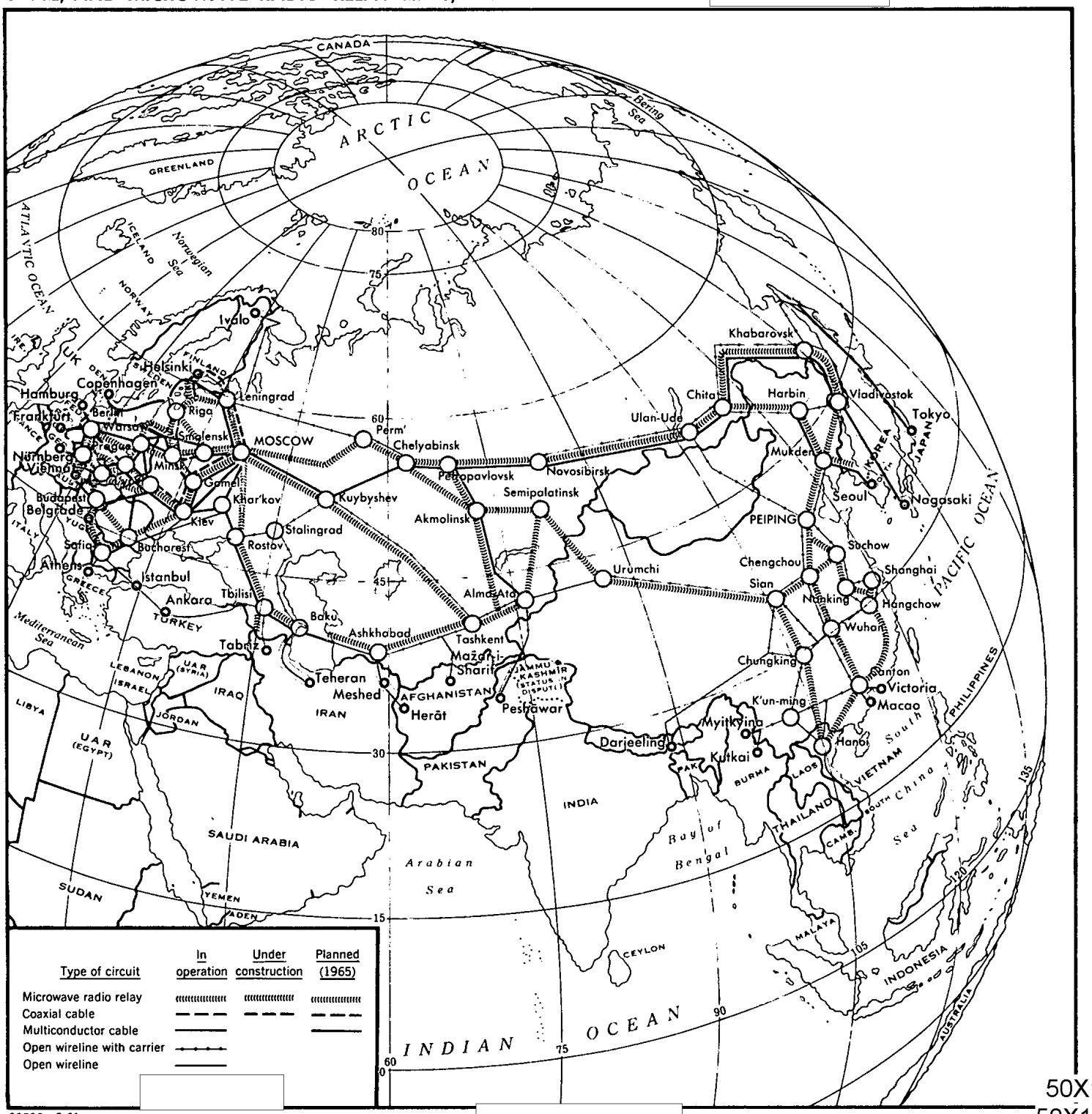
Almost independent of the growth of telephone, telegraph, and common facilities was that of intra-Bloc and international broadcasting. Long before 1950 the countries of the Bloc were strongly conscious of the propaganda capabilities of broadcasting. Under the auspices of the International Radiobroadcasting and Television Organization (OIRT),*

* OIRT, a Bloc-dominated organization, effects cooperation among the Bloc and some non-Bloc member countries (Finland, Iraq, the United Arab Republic, and Yugoslavia) in the field of radiobroadcasting and television.

SINO-SOVIET BLOC: MAIN INTERNATIONAL WIRELINE, CABLE, AND MICROWAVE RADIO RELAY LINES, 1960 AND 1965

FIGURE 6

50X1



Type of circuit	In operation	Under construction	Planned (1965)
Microwave radio relay			
Coaxial cable			
Multiconductor cable			
Open wireline with carrier			
Open wireline			

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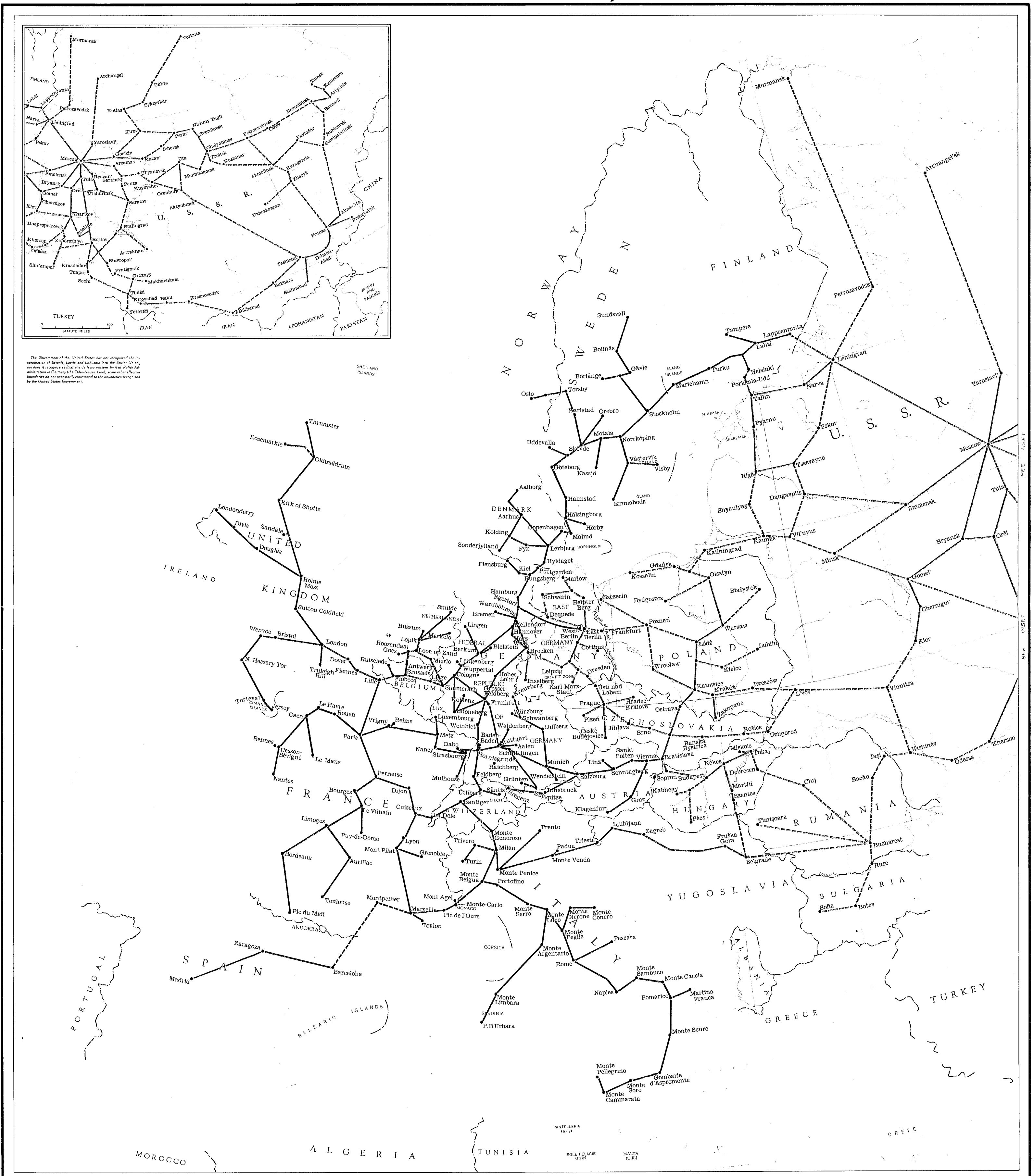
50X1

50X1

"Intervision" and "Eurovision" Television Networks, 1960 and 1965

FIGURE 10



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"INTERVISION" "EUROVISION"

In operation

Under construction or planned for completion by 1965

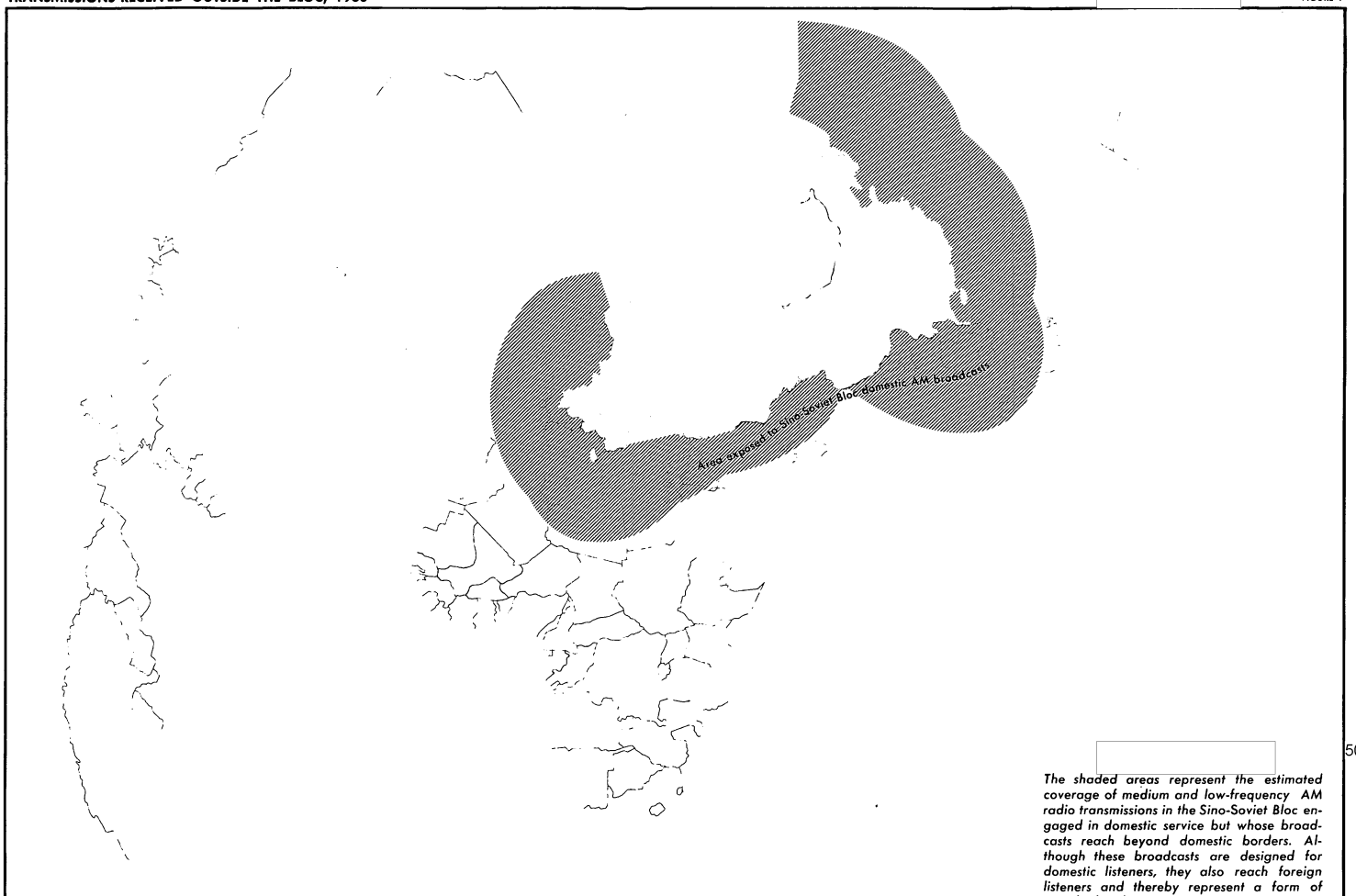
Statute Miles: 0 100 200 300 400 500

Kilometers: 0 100 200 300 400 500

50X1

SINO-SOVIET BLOC: COVERAGE OF DOMESTIC AMPLITUDE-MODULATED RADIOBROADCASTING TRANSMISSIONS RECEIVED OUTSIDE THE BLOC, 1960

FIGURE 7 50X1



50X1

The shaded areas represent the estimated coverage of medium and low-frequency AM radio transmissions in the Sino-Soviet Bloc engaged in domestic service but whose broadcasts reach beyond domestic borders. Although these broadcasts are designed for domestic listeners, they also reach foreign listeners and thereby represent a form of outside-the-Bloc coverage.

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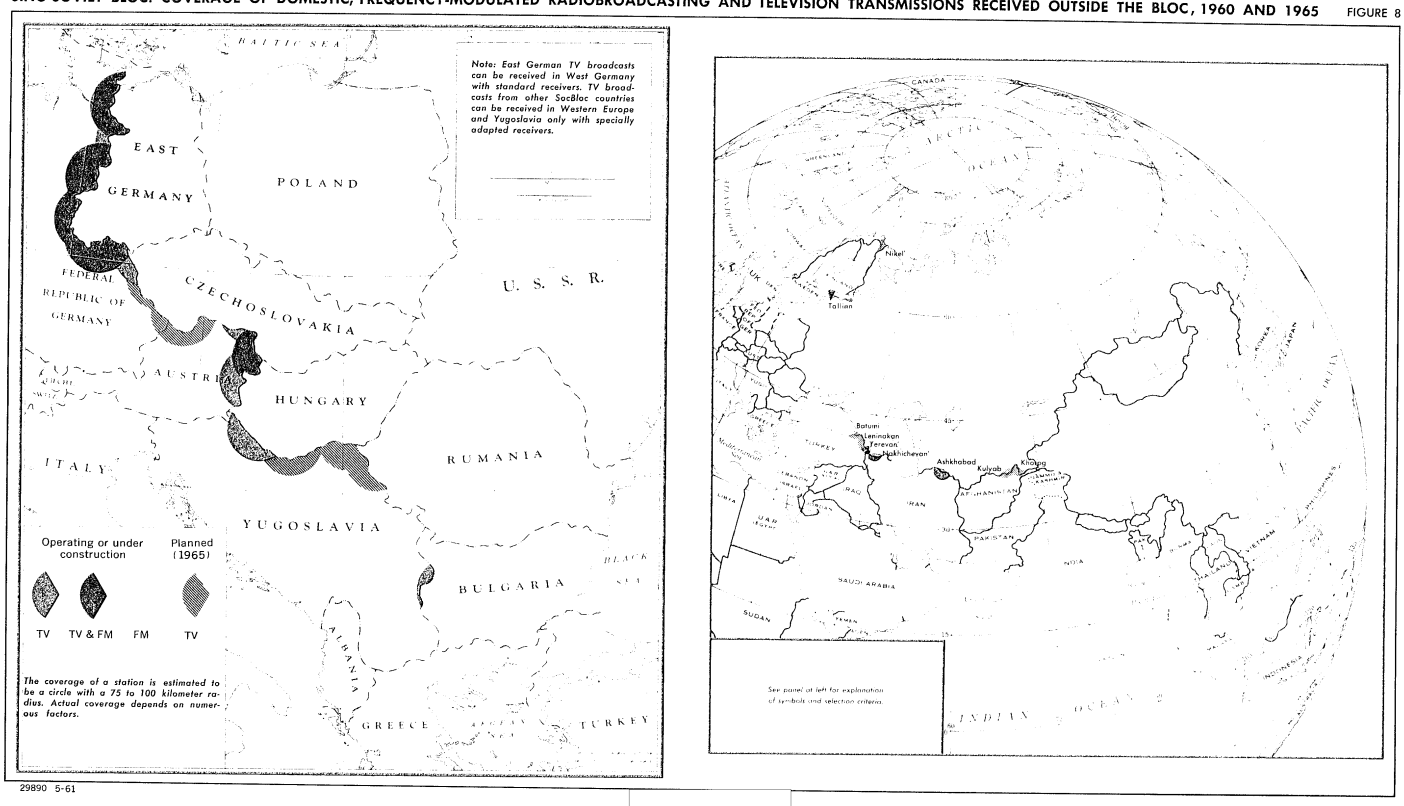
50X1

50X1

SINO-SOVIET BLOC: COVERAGE OF DOMESTIC, FREQUENCY-MODULATED RADIOBROADCASTING AND TELEVISION TRANSMISSIONS RECEIVED OUTSIDE THE BLOC, 1960 AND 1965 FIGURE 8



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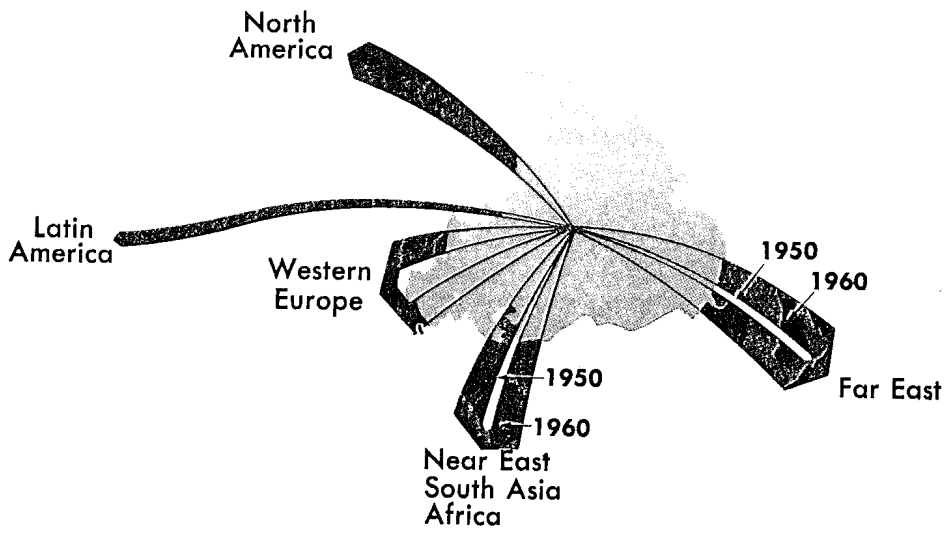
50X1

FIGURE 9

SINO-SOVIET BLOC: MAIN TARGET AREAS AND PROGRAM HOURS OF INTERNATIONAL RADIOBROADCASTING, 1950 AND 1960



Main target area	Weekly hours of radiobroadcasting		Percent of total hours	
	1950	1960	1950	1960
Western Europe	380	889	52	31
Far East	145	807	20	28
Near East, South Asia and Africa	131	745	18	26
North America	57	276	8	9
Latin America	18	167	2	6
Total*	731	2884	100	100

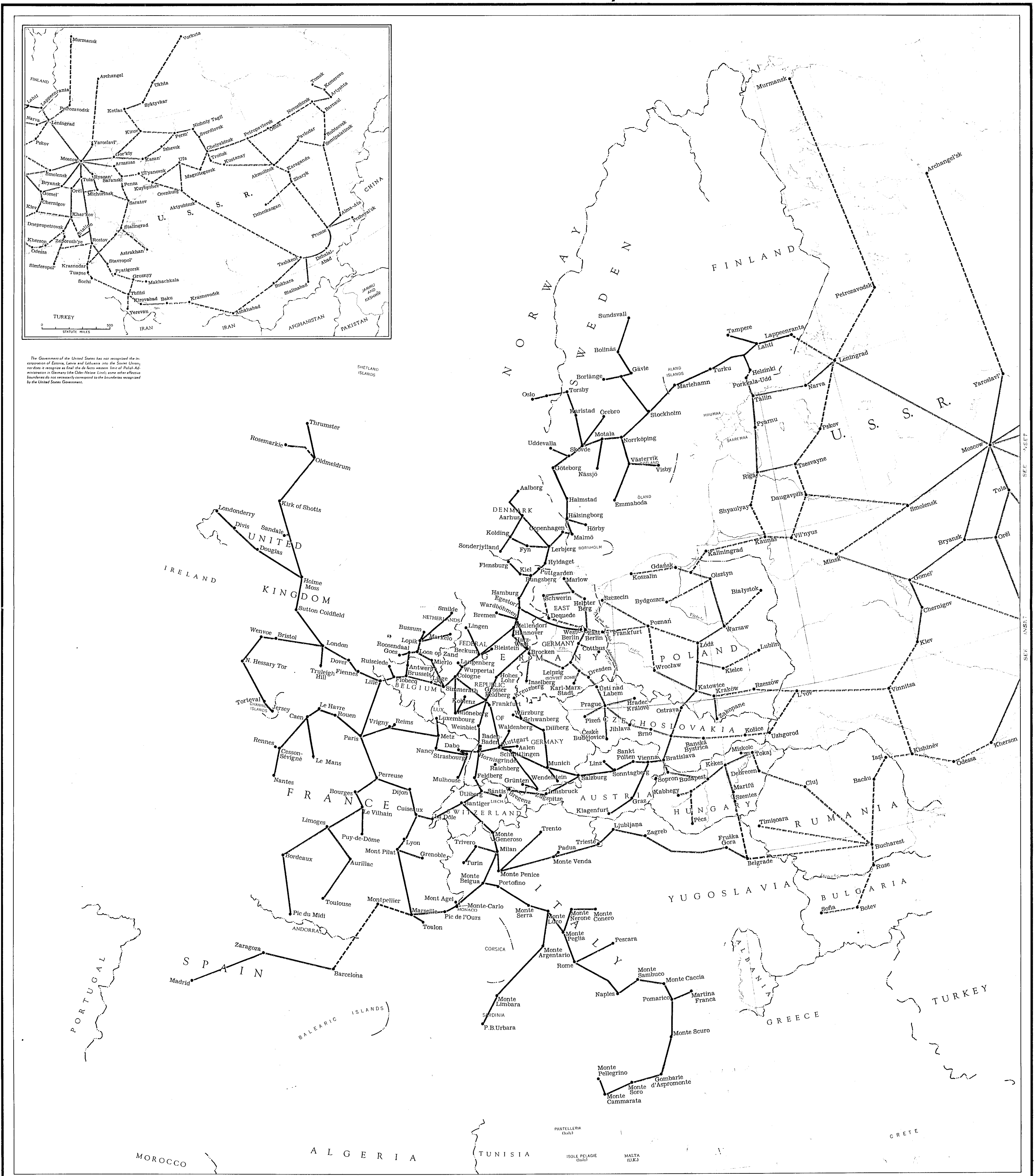
(Excludes 156 hours in 1950 and 210 hours in 1960 not assignable to the above categories.)

29530

50X1

"Intervision" and "Eurovision" Television Networks, 1960 and 1965

FIGURE 10



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"INTERVISION"		"EUROVISION"
———	In operation	———
– – – –	Under construction or planned for completion by 1965	– – – –

0 100 200 300 400 500 Statute Miles

0 100 200 300 400 500 Kilometers

50X1

a constant exchange of ideas and programs has been fostered. Most of the interest in broadcasting has been in the international aspects inasmuch as only the USSR has broadcast within the Bloc (to the European Satellites) since 1950. The USSR broadcast 156 hours per week in 1950 but only 58 hours per week in 1960.

The decline in intra-Bloc radiobroadcasting has been matched by an upsurge in intra-Bloc television broadcasting. Besides an ever-increasing number of program exchanges, "live" television broadcasts began to be received in Czechoslovakia, East Germany, Hungary, and Poland in 1959 through what later became the "Intervision" network.

Since 1950, international radiobroadcasting coverage has increased and has been improved by the addition of more powerful transmitters. The total hours of international radiobroadcasting of the Bloc grew from 730 hours per week in 1950 to about 2,900 hours per week in 1960. The distribution of these hours among target areas, as shown on the map, Figure 9,* changed radically in favor of underdeveloped countries during this period. 6/

International television broadcasting occurs along the border areas between the Soviet Bloc and Western Europe as indicated on the map, Figure 10.* Also, in 1960 an agreement was reached between the OIRT and the European Broadcasting Union (EBU), which represents the countries of Western Europe in regional radio and television matters, arranging for the exchange of "live" television programs. 7/

B. Problems Affecting Growth

1. Capital, Labor, and Equipment

Inadequacies in the growth of intra-Bloc and international telecommunications arose largely from shortages in capital, skilled labor, and modern equipment. From 1950 to about 1958, funds for capital investment were insufficient to provide for a balanced growth [redacted] 50X1 As a consequence, growth in telephone and telegraph service during this period was accomplished mainly by the overly intensive development and use of existing facilities. Reserve capacity for heavy traffic loads was largely diminished. The time necessary to make a telephone call or to send a telegram increased. Maintenance costs rose. By 1958 it is believed that further intensive development was impractical and that greater capital investments for new, modern facilities had to be made if service was to continue to expand. This

* Following p. 6, above.

[redacted] 50X1

conclusion generally has been borne out by available plans for the development of telephone and telegraph in the Bloc during 1959-65. 9/

Another problem in the development of telecommunications has been the shortage of skilled labor. It has been difficult and sometimes impossible to recruit sufficient numbers of qualified technicians to install, operate, and maintain the newer, more complex telecommunications equipment. As a result, substantial efforts have been made and are being made to train more and better technicians, but it is likely that this shortage of skilled labor will remain a critical factor in the development of telecommunications through 1965.

The general policy of the Bloc for self-sufficiency has resulted in the attempt to develop domestic research and production facilities to supply its needs for telecommunications equipment. Although achieving a measure of success in the manufacture of relatively unsophisticated types of equipment, the telecommunications equipment industry, handicapped by shortcomings in both engineering and manufacturing capabilities, still cannot supply modern types of equipment in adequate quality and quantity. Because of the trade limitations of COCOM agreements, imports have not been able to fill this need. Consequently, shortages in modern telecommunications equipment have restricted the pace at which this equipment might otherwise have been employed. 10/

Another problem exists in the complex and time-consuming process involved in installing a modern cable line and its associated facilities. In order to effect this installation, intricate testing equipment and highly skilled technicians or engineers are required, both of which have been difficult to bring together in adequate numbers and abilities. These problems likely will continue to harass telecommunications authorities of the Bloc. 11/

2. Standardization

The worldwide authorities on technical standards for international telecommunications are the permanent technical committees of the International Telecommunication Union (ITU): the International Telegraph and Telephone Consultative Committee (CCITT) and the International Radio Consultative Committee (CCIR). Probably most of the countries of the Bloc at one time or another have adopted some of the international standards of the ITU. With the advent of organizations representing the Bloc in telecommunications matters, such as OSS, CEMA, and OIRT, a uniform standard for all countries of the Bloc likely will become mandatory under Soviet pressure.

The lack of standardization of telecommunications equipment and systems has seriously limited the smooth flow of telecommunications within the Bloc and between the Bloc and the rest of the world. Before 1950 the telecommunications authorities of the Bloc paid little heed to the technical standards used by their neighboring countries. The common facilities used for international telecommunications services generally tried to adhere to guidelines established by the ITU, but usually the internal systems were not so engineered, being of a somewhat lesser quality. As relations among countries of the Bloc expanded, however, it became apparent that the telecommunications lines between countries were insufficient to handle the increasing volume of traffic. The different technical standards of the domestic telecommunications systems severely limited the capability of intra-Bloc telecommunications to reach beyond main terminal centers. Accordingly, attention had to be devoted to the question of common technical standards. Within the Bloc this issue was highly complicated, technically and financially.

At the present time, technical standards recommended by the ITU generally are being chosen by the Bloc. In some instances, however, sizable investments in facilities based on other standards led to the adoption of those standards. This situation occurred in television broadcasting. As a consequence, television transmissions of the Bloc cannot be received in western Europe unless signals are converted to western European standards or unless western European television receivers are converted to Bloc standards.* The trend remains, however, that the Bloc is adopting ITU standards wherever possible even though technical problems probably will continue to be uncovered within the Bloc as plans for integration unfold and between the Bloc and the Free World as more cultural and commercial contacts are established. 12/

IV. Plans and Progress, 1961-65

A. Integration

The movement toward integration of intra-Bloc telecommunications facilities is centered on the work of OSS. This organization has brought about the planning and coordination of many intra-Bloc facilities designed to enhance the compatibility of the basic telecommunications systems of Bloc countries. Some of these planned

* East Germany is an exception to the rule in the Bloc inasmuch as it uses the television broadcasting standard recommended by the ITU. The rationale for this exception was that television is such an important propaganda weapon in the duel between East and West Germany that East Germany had to adopt the ITU standard in order to reach West German viewers.

facilities, shown in the map, Figure 1,* are the coaxial cable line connecting Moscow with major cities in the European Satellites and the microwave radio relay lines connecting major cities in the USSR with those in the European Satellites and Communist China. Most of the pressure for intra-Bloc automation of telephone and telegraph communications and for intra-Bloc agreements on technical standards and research programs comes from the USSR through the OSS mechanism. 13/

CEMA, through Section 9 (Radio Technology and Means of Communication) of its Committee for Machine Building, also helps to effect integration of telecommunications systems of the Bloc. Its main impact is on the manufacture and development of telecommunications equipment that is to be used by the USSR and the European Satellites. At the present time the role of CEMA appears to be of an advisory nature, specifying the manufacture of certain types of telecommunications equipment but no longer specifying which countries are to manufacture the equipment. It is believed that CEMA eventually will reassume the role of assigning manufacturing responsibilities to certain countries but will allow other countries to do as they wish -- a system of preferential Socialist competition. 14/

The OIRT participates in this effort toward integration of telecommunications facilities through its interest in network facilities for radiobroadcasting and television. "Intervision," the planned television network to connect countries of the OIRT, is a major program promoted by OIRT. Through technical commissions the OIRT recommends standards and procedures for its member countries. Inasmuch as these activities of OIRT overlap with those of OSS and CEMA, a definite level of coordination probably is maintained among these organizations. Although the formal mechanism for this coordination is not known, it is believed that many of the people who work on the various technical commissions of these organizations are the same. 15/

Inseparable from this discussion of integration is that of standardization. The integration of telecommunications systems must be based on compatible standards for equipment and facilities if heavy investment in conversion equipment is to be avoided. It follows, therefore, that implementation of plans for the integration of intra-Bloc telecommunications systems is dependent on the successes achieved in standardization.

B. Reliability

The reliability of telecommunications among the countries of the Bloc is being improved by providing several dispersed mainline

* Following p. 4, above.

routes, by using different types of media on the same route, and by "hardening" mainline routes. The map, Figure 1,** illustrates the first two ways of improving reliability. The several mainline routes interconnecting the USSR and the European Satellites cross borders at widely separated points. Inasmuch as a communication could be carried on any of these lines, their dispersion improves the chances of uninterrupted communications. The utilization of more than one type of medium, as in the case of coaxial cable and microwave radio relay lines between Moscow and East Berlin, is another way to improve reliability. Provision may be made at key points along the route to switch rapidly from one medium to the other in the event of disruption. 50X1

50X1

C. Capacity***

The construction of high-capacity intra-Bloc telecommunications lines, which require large initial investments but low per channel costs, will be a major undertaking for the Bloc during 1961-65. Microwave radio relay and coaxial cable lines probably were extended by about four times their length in 1960. Other modern types of high-capacity lines such as tropospheric scatter also are being increasingly

50X1

** Following p. 4, above.

*** Capacity is spoken of in terms of so many 4-kilocycle telephone channels, although it should be understood that capacity also could be measured in terms of telegraph channels, television channels, or some technical unit of measurement.

employed. Their full capabilities, however, probably will not be realized until some time after 1965.

Although the number of lines to be constructed is impressive, the increase in telephone channel capacity is even more impressive. For example, the total number of landline telephone channels available between the USSR and the European Satellites was estimated to be about 500 in 1959. The coaxial cable and four microwave radio relay lines planned for completion by 1965 will multiply this number by at least 10 times. 17/

Progress in the automation of the domestic telephone networks of the countries of the Bloc also enhances the significance of this increase in telephone channel capacity. An automatic intra-Bloc telephone network would increase the efficiency of these channels many times over by substantially reducing the time necessary to place a telephone call. The advantages of a completely automated telephone network, however, probably will not be realized before 1975.

The completion of these planned mainlines by 1965 would afford telephone channel capacity or its equivalent in excess of the estimated amount required for civil telecommunications during 1961-65, unless consumer demand stimulated by higher standards of living can absorb it. Even a generous allowance for such military uses as air defense and guided missile control systems leaves capacity not specifically allocated. The planned telephone channel capacity may mean that some consideration for future intra-Bloc and international needs even beyond 1965 is being taken before the needs arise. In this event, this capacity reflects an appreciation for the efficiency and flexibility that such large, multipurpose systems provide and a willingness to use scarce resources for telecommunications facilities that will not immediately be operated at their full capacity.

V. Prospects

The prospects for the successful completion of the plans for intra-Bloc and international telecommunications are good. Those facilities indicated as under construction and planned, as shown in the maps, Figures 1* and 5** probably will be completed and functioning by 1965, although most of the facilities were planned to be completed before 1965. The regular services such as telephone and telegraph will be expanded, and the new services such as TELEX, facsimile, and data transmission introduced in the late 1950's probably will have grown into major services by 1965. For intra-Bloc users these facilities

* Following p. 4, above.
** Following p. 6, above.

and services will provide a wide field of applications ranging from handling telegrams to transmitting radar video information. They also will be used for relaying radiobroadcasting and television programs throughout the Bloc for simultaneous listening and viewing. For international users these facilities and services will provide a wide range of services but not so broad as that for intra-Bloc users. [redacted] 50X1

50X1

[redacted]

Although the plans for intra-Bloc and international telecommunications likely will be fulfilled, there are some unknown factors that may adversely affect these plans. The ability of the Bloc to develop, produce, install, and operate broad-band telecommunications systems, aggravated by the shortage of skilled labor, may prove to delay the prospects of expanding service. Also, questions associated with integrating the telecommunications systems of the countries of the Bloc, such as problems of standardization, probably will continue to plague the achievement of the economic programs and plans for telecommunications among the countries of the Bloc and between the Bloc and the rest of the world.

APPENDIX A

GLOSSARY OF TECHNICAL TERMS

Amplitude modulation (AM): The process by which a selected carrier frequency is varied in magnitude (amplitude) by other frequencies that contain the information to be transmitted in telecommunications. (See Frequency modulation.)

Apparatus: Instruments, machines, appliances, and other assemblies used in providing a telecommunications facility.

Automatic (as an adjective): Of or pertaining to any process involved in producing telecommunications service which does not require direct, immediate human assistance.

Band (of frequencies): The entire range of frequencies between two numerically specified frequency limits. The magnitude of this range is a limiting factor on the amount of information that can be transmitted in telecommunications. With respect to frequencies of the radio spectrum as a whole, the International Telecommunication Union has for convenience divided the whole radio spectrum into eight major bands, as follows:

Frequency Bands		
Range	Type	Corresponding Wave* Band
30 kc** and below	Very low frequencies (VLF)	Myriametric waves
30 to 300 kc	Low frequencies (LF)	Kilometric waves
300 to 3,000 kc	Medium frequencies (MF)	Hectometric waves
3,000 to 30,000 kc	High frequencies (HF)	Decametric waves
30,000 kc to 300 mc***	Very high frequencies (VHF)	Metric waves
300 to 3,000 mc	Ultra high frequencies (UHF)	Decimetric waves****
3,000 to 30,000 mc	Super high frequencies (SHF)	Centimetric waves****
30,000 to 300,000 mc	Extremely high frequencies (EHF)	Millimetric waves****

* Waves are undulating disturbances: a sound wave is a disturbance in the air, which is an elastic medium, and an electric wave is a disturbance in any medium whatever. The number of waves per second is the frequency of a given wave. Because the speed of wave propagation is considered to be constant, the length of a given wave is in inverse relation to its frequency: the longer the wave length, the lower the frequency, and the shorter the wave /footnote continued on following page/

Cable: A bundle of sheathed, insulated wires and/or coaxial tubes, used as a telecommunications medium. It is sometimes referred to as "multiconductor cable."

Carrier (as an adjective): Of or pertaining to a technique for dividing a circuit, lane, supergroup, group, or channel into portions which can be used independently of and simultaneously with all other portions. Different frequencies or different pulses are selected for each portion to "carry" the information to be transmitted, after alteration by the information frequencies. The carrier itself need not be transmitted.

Channel: A portion, electrical or physical, of a telecommunications circuit, lane, supergroup, or group which can be used to transmit information independently of and simultaneously with all other portions. A channel may be used to provide two or more subchannels.

Circuit: A telecommunications connection between two or more distant points by a wire, cable, or radio medium facility used to carry information. The circuit is the fundamental telecommunications connection between distant points. By the application of appropriate techniques, a circuit may be arranged in many different combinations to meet the need for various kinds and quantities of telecommunications service. In its simplest form a circuit may carry only single telecommunications units in sequence. In its most complex form it may by apportionment carry simultaneously thousands of telephone channels and telegraph subchannels; a number of television programs; and other specialized kinds of service, such as high-fidelity broadcast programs, radar signals, and data-processing signals.

For the most complex application, a circuit is often arranged into lanes, each of which can carry, in one direction, 1 television program or up to 1,800 telephone channels. In turn, these 1,800 telephone channels are subdivided into 10 supergroups of 60 telephone channels each. Each supergroup is subdivided into 5 groups of 12 telephone channels each. One or more telephone channels may be further subdivided into three to twenty 60-word-per-minute teletype subchannels. Other specialized kinds of service may be accommodated by combining two or more telephone channels.

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length the higher the frequency. Wave length is usually measured in linear units of the metric system.

** Kilocycles per second, or 1,000 cycles per second.

*** Megacycles per second, or 1 million cycles per second.

**** It is becoming common usage to refer to waves (frequencies) in these three bands as "microwaves."

Coaxial (as an adjective): Of or pertaining to a modern telecommunications cable medium technique using one or more tubes (sometimes called "pipes"). Each metal tube surrounds a conducting wire supported concentrically by insulators. The space in the tube usually contains nitrogen gas under pressure. Generally, coaxial cable is used for the transmission of information in complex form, such as radar, computer data, or television signals, and/or for the transmission of telephone channels and telegraph subchannels. A single tube usually carries information in only one direction at a time. The capacity of a tube depends in part upon the distance between repeater stations. In the standard facility, which may have from 2 to 8 tubes in the cable, a single tube carries a lane of up to 1,800 telephone channels or 1 television lane, for which the repeater station spacing is about 7 statute miles. In a new developmental coaxial cable facility, a single tube may carry 3 lanes of a total of 1,800 telephone channels or 3 television lanes, for which the repeater station spacing is expected to be about 3 statute miles.

Electronics: A general term used to identify that branch of electrical science and technology that treats of the behavior of electrons in vacuums, gases, or solids. Today telecommunications makes extensive use of electronic technology.

Facility: An association of apparatus, material, and electrical energy required to furnish telecommunications service.

Facsimile (as an adjective): Of or pertaining to a telecommunications (telegraph) service in which photographs, drawings, handwriting, and printed matter are transmitted for graphically recorded reception. In one method (Type A), images are built up of lines or dots of constant intensity. In another method (Type B), images are built up of lines or dots of varying intensity, sometimes referred to as "telephoto" and "photoradio."

Feeder (as an adjective): Of or pertaining to telecommunications facilities of relatively low capacity which join facilities of relatively high capacity. (See Main.)

Frequency: The rate in cycles per second at which an electric current, voltage, wave, or field alternates in amplitude and/or direction. (See Band.)

Frequency modulation (FM): The process by which a selected carrier frequency is varied in frequency by other frequencies that contain the information to be transmitted in telecommunications. (See Amplitude modulation.)

Functional (as an adjective): Of, pertaining to, or connected with special, unique, or particular telecommunications facilities managed and operated by a single agency, organization, company, department, committee, ministry, or other entity, in contrast to the facilities of a basic system. (See Basic system.)

Group: A number of channels (usually 12) or subchannels combined (multiplexed) electrically in building up the total capacity of a telecommunications circuit, lane, or supergroup.

Ionosphere: Those layers of the earth's atmosphere occupying the space about 210 statute miles in thickness extending from about 30 statute miles above the earth's surface to the outer reaches (exosphere) of the atmosphere. Reflection from these layers makes possible long-distance transmission of radio signals. The layers, however, are responsible for fading of signals, skip distance, and differences between daytime and nighttime radio reception. They are also used as a scattering reflector for ionosphere scatter-transmission techniques to transmit to distances of about 1,000 to 1,500 statute miles.

Joint facility: A telecommunications facility owned, controlled, or operated by two or more agencies, organizations, companies, departments, committees, ministries, or other entities.

Lane: A 1-way portion, electrical or physical, of a 2-way telecommunications circuit which can be used independently of and simultaneously with all other portions. The largest lane today can handle 600 telephone channels or 1 television program. In some applications the direction of a lane may be reversed.

Leased (as an adjective): Of or pertaining to the direct operation by a user of a telecommunications facility owned by another agency.

Line: A general term used to delineate a telecommunications circuit facility (wire, cable, or radio).

Main (as an adjective): Of or pertaining to telecommunications facilities at and between principal cities and centers which have relatively high capacity compared with feeder facilities. (See Feeder.)

Medium: Any substance or space that can be used practically to transmit a form of electrical energy for the purpose of providing telecommunications service.

Microwave radio relay (as an adjective): Of or pertaining to a radio medium technique in modern telecommunications employing radio

frequencies higher than 300 mc. These frequencies do not normally afford practical direct transmission to great distances, principally because they do not bend well around the earth's surface and because they do not reflect well from the ionosphere. They are, however, capable of reliable transmission from horizon to horizon (line-of-sight) by the use of special antennas which concentrate the radio energy and give it desired direction. Great distances can, in consequence, be reached by this technique by the interposition of relay stations along the route of the line with a spacing interval of from 25 to 40 statute miles, depending upon terrain conditions. This technique can be employed practically to carry from a small number of telephone channels and telegraph subchannels to thousands of such channels and subchannels through 2 or more lanes and to carry 1 or more television and other specialized lanes and channels. (See Band.)

Mobile (as an adjective): Of or pertaining to a telecommunications facility which is intended to be operational while in motion or during halts at unspecified points. (See Portable.)

Modulation: The process of altering a carrier frequency or carrier pulses by other frequencies or pulses representing the information being transmitted.

Multiplex (as an adjective): Of or pertaining to the combining of information signals, modulated or unmodulated, of two or more lanes, supergroups, groups, channels, or subchannels for transmission over the same circuit.

Network: An interconnection, electrical or physical, of two or more circuits or portions thereof for the purpose of facilitating telecommunications service.

Point-to-point (as an adjective): Generally, of or pertaining to telecommunications service between fixed points, using the radio medium.

Portable (as an adjective): Of or pertaining to a telecommunications facility which can be readily moved from place to place but is not normally operational while in motion. (See Mobile.)

Private (as an adjective): Belonging to or concerning an individual person, organization, institution, or activity; not public or common.

Pulse: A spurt of electrical energy of extremely short duration (usually measured in millionths of a second), yet capable of being used in telecommunications to transmit information.

Quad: In a multiconductor telecommunications cable, the physical association of a group of 4 conductors in any one of various arrangements for the purpose of providing 2-way multichannel operation.

Reception base: The aggregate telecommunications receiving facilities employed in providing a broadcast service.

Route: The geographical path followed by a wire, cable, or radio line.

Scatter (as an adjective): Of or pertaining to a radio medium technique in modern telecommunications by which energy in radio frequencies above 30 mc is deliberately scattered into one or the other of two reflecting portions of the atmosphere (troposphere and ionosphere) at a predetermined angle such that a usable portion of the energy arrives at the desired receiving location. This technique is especially applicable to regions in high latitudes (Arctic and Antarctic) where facilities of other media suffer from the rigors of weather and terrain and where the conventional long-distance radio media of the lower frequency bands (200 kc to 30 mc) are subject to serious disruptive propagational anomalies. (See Band.)

Subchannel: A portion, electrical or physical, of a telecommunications channel which can be used independently of and simultaneously with all other portions. An appreciable number of telephone channels can usually be subchanneled to carry from three to twenty 60-word-per-minute teletype subchannels on each telephone channel so employed.

Subscriber: Any customer who directly operates telecommunications apparatus in obtaining telecommunications service.

Supergroup: A number of groups (often five) combined (multiplexed) electrically in building up the total capacity of a telecommunications circuit or lane.

System: All of the facilities and networks managed by a single agency, organization, company, department, committee, ministry, or other entity in rendering either functional or basic telecommunications service.

Telecommunications: Transmission, reception, or exchange of information between distant points by electrical energy over a wire, cable, or radio medium facility to produce telephone, telegraph, facsimile, broadcast (aural and visual), and other similar services.

Teletype (as an adjective): Of or pertaining to a technique for effecting telegraph service by the use of an apparatus similar to a typewriter in which information is transmitted by keyboard and received by type printer on a roll of paper, on a roll of tape, or by perforations on a roll of tape, or both. (Sometimes called a "teleprinter" or "teletypewriter.")

Transmission base: The aggregate telecommunications transmitting facilities employed in providing broadcast service.

Transistor: A modern device which is capable of performing in a solid (germanium or silicon) many of the functions performed by the conventional electronic tube in a gas or vacuum.

Troposphere: The layer of the earth's atmosphere occupying the space from the earth's surface to a height of about 6 statute miles. This layer is used as a scattering reflector for tropospheric scatter transmission techniques to distances of about 200 to 500 statute miles.

Wave guide (as an adjective): Of or pertaining to a telecommunications medium, now under development in several countries, which may be capable of transmitting extremely large amounts of conventional and complex information. It consists of a circular or rectangular hollow metallic tube in which electrical energy travels in the form of waves, much as do sound waves in a speaking tube.

Wire diffusion: Distribution of broadcast programs by a wire or cable medium to wired loudspeakers.

Wired loudspeakers: A telecommunications loudspeaker which receives from a distribution point one or more broadcast programs by a wire or cable medium.

Wireline: A general term used to identify a line consisting of either an aerial cable (and/or separate wires) or underground cable, used as a telecommunications medium.

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